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Short communication

Sensorial and physico-chemical attributes of Nagpur mandarin fruit coated with Carnuba wax under refrigerated conditions

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In India, citrus is one of the very important fruit crop, occupied third place after mango and banana both in acreage and production. However, loose jacketed Nagpur mandarin (*Citrus reticulata* Blanco), is well known cultivar for easy peeling in nature having, excellent aroma and flavour. In general, the post-harvest losses have been recorded substantially in Nagpur mandarin due to several factors involved in value chain from fruit harvesting to consumption. These losses can be minimized with the adoption of advance technologies to extend the marketing distance and holding periods of commodities after harvest. In recent year, the performance of various wax micro-emulsion as food and fruit edible coatings were evaluated for extended shelf-life that act as a semipermeable barrier against gases, moisture and solute movement to reduce the respiration, water loss and oxidation reaction rates (El-Anany *et al*., 6; Cuquerella and Martinez-Javega, 4). The anaerobic conditions lead to the production of off-flavours, which are associated with the loss of fruit quality. Mandarin fruits are sensitive to anaerobic respiration (Cohen *et al.*, 3). Carnuba wax emulsions have broad FDA approval for food contact applications and are considered as 'Queen of wax'. There are evidences indicating that carnuba wax coated fruits have extended shelf-life. The influence of coating on the physico-chemical parameters of citrus fruit has been widely studied (Marcilla *et al.*, 8). However, carnuba wax is botanical natural carnuba palm product has yet not been tried for citrus fruits and is lacking in Nagpur mandarin. Therefore, an attempt has been made to study the effect of differential concentration of carnuba wax on shelf-life and sensory attributes of Nagpur mandarin *mrig* fruits (summer crop) under refrigerated storage conditions.

Nagpur mandarin *mrig* fruits were harvested at commercial maturity from a private orchard located in Nagpur. The study was conducted in the post-harvest laboratory at NRC for Citrus, Nagpur during 2009-2010. Efforts were made to select the fruits of uniform size, shape and weight and colour, free of physical damage, and were were then washed in running water and cleaned with muslin cloth. The fruits were dipped in different concentrations of carnuba wax, *viz*., 5, 10, 15 and 20% and 6% Stafresh®. The treated fruits were completely air-dried at ambient conditions. A total of 25 fruits as unit in each treatment with four replications were tested in CRD design. The fruits were packed in CFB boxes and stored at 6 ± 1^0C with 90% RH up to 60 days. Stored fruits were subjected to physico-chemical and sensory analysis periodically. Physiological loss in weight was referred to initial fruit weight (g) and expressed in percentage. Fruit firmness was measured with hand-held penetrometer (Model FT 327, McCormick Fruit tester, USA) equipped with cylindrical probe and results were expressed in Newton (N). Total soluble solid (TSS) was determined by a hand refractometer (Kruss, Germany) and vitamin 'C' and titrable acidity was determined by AOAC (1) and expressed in percentage. Sensory attributes was evaluated at room temperature by a panel of judges comprising male and female of different cadre. Five fruits samples in each treatment were analysed for each parameter, *viz.* colour, flavour, texture and sweetness on a nine point hedonic scale. Mineral water was provided as palate cleanser between samples.

Study revealed that physiological loss in weight increased with increase in storage duration. The fruits coated with 10% carnuba wax concentration were found most effective in preventing physiological loss in weight and recorded least loss (7.44%) than that of remaining treatments possibly because of mechanism associated with vapour-phase diffusion and respiration causes weight reduction (Baldwin *et al.*, 2). In general, fruit firmness decreased significantly during the storage period but fruits coated with 10% carnuba wax retained 29.28 N firmness with a juice recovery of 42.54% at the end of 60 days under refrigerated storage conditions, which might be due to double action of wax coating barrier and cooling effect under refrigerated conditions (Table 1). The result also revealed that total soluble solid content was recorded to be higher as 9.80% during storage period. However, many variations were not observed in TSS (total soluble solids) with differential treatment of carnuba wax as it was evidenced by Salvador (9) in citrus fruit. This might be possibly due to increased in hydrolysis of polysaccharides into mono- and di-saccharides. Similar results were reported by Dhatt

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Table 1. Effect of edible coatings on physico-chemical parameters of (*Mrig bahar*) Nagpur mandarin fruits in refrigerated conditions.

Coating treatment	60 days of storage					
	PLW (%)	Juice (%)	TSS (%)	Acidity (%)	Firmness (N)	Vit. C (mg/100 ml)
CW (5%)	8.02	39.54	9.80	0.31	28.30	13.75
CW (10%)	7.44	42.64	9.80	0.30	29.28	18.50
CW (15%)	10.03	39.66	9.25	0.37	25.54	13.25
CW (20%)	9.48	40.39	9.85	0.38	29.16	13.75
ST (6%)	10.13	34.96	9.78	0.39	24.18	14.25
CD (P = 0.05)	1.95	5.6	NS	0.06	3.84	3.29

CW = Carnuba wax; ST = Stafresh wax

et al. (5) in Kinnow mandarin. Vitamin 'C' content was recorded higher (18.50 mg/100 ml) suggesting its better retention with 10% Carnuba wax coating treatment (Table 1). Decrease in titrable acidity in Nagpur mandarin fruits were recorded in 10% wax treated fruits under refrigerated storage condition. This decrease in acidity during storage might be due to the utilization of organic acid in respiratory process. Similar report was also found by Josan *et al.* (7) in mandarin. This treatment which has registered the maximum score for fruit sweetness and flavour (6.3), colour and texture (7.30) by panelists (Fig. 1). The texture of the fruit in relation to fruit shriveling was noted to be better with this treatment. This happens as flavour depends on a delicate balance of sugars, acids, phenolics and aromatic compounds, with a number of additional factors, such as texture and visual appearance also influence the perceived quality and consumer acceptance and appreciation (Randhawa, *et al.*, 10).

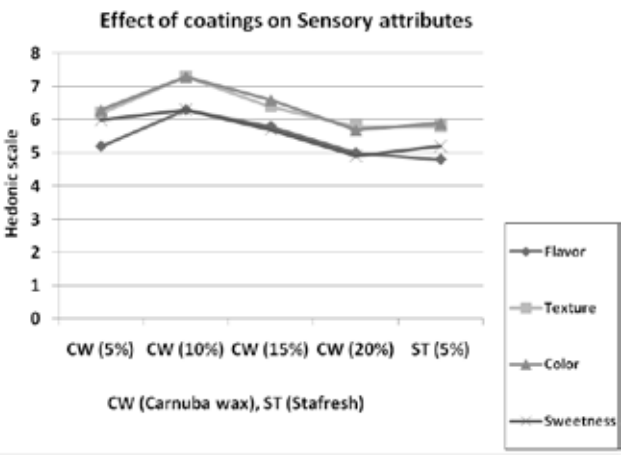

Fig. 1. Effect of carnuba wax coatings on sensory attributes of Nagpur mandarin fruits.

The results indicated that the quality of *mrig bahar* Nagpur mandarin fruits both physico-chemical parameters and sensory attributes were found to be better with 10% edible carnuba wax coating treated fruits at low temperature storage which may promote the entrepreneur for export of Nagpur mandarin fruits.

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REFERENCES

1. A.O.A.C. 2000. *Official Methods of Analysis.* Association of Analytical Chemists. (17th Edn.) Washington, D.C.

2. Baldwin, E.A., Niesperos, M.O., Shaw, P.E. and Burns, J.K. 1995. Effects of coating and prolonged storage condition on fresh orange flavour volatiles, degrees brix and ascorbic acid levels. *J. Agric. Food Chem*. **43**: 1321-31.

3. Cohen, E., Shalom, Y. and Rosenberger, I. 1990. Postharvest ethanol build up and odd flavor in Murcott tangerine fruits. *J. American Soc. Hort. Sci.* **115**: 775-78.

4. Cuquerella, J. and Martinez-Javega, J.M. 1984. Waxing of Spanish citrus fruits. *Proc. Intl. Soc. Citri.* **1**: 494-96.

5. Dhatt, A.S., Randhawa, J.S. and Singh, S.N. 1991. Effects of individual seal packaging of high density polyethylene (HDPE) film on storage life and quality of 'Kinnow'. *J. Plant Sci. Res.* **7**: 84-85.

6. El-Anany, A.M., Hassan, G.F.A. and Rehab Ali,

F.M. 2009. Effects of edible coatings on the shelf life and quality of Anna Apple (*Malus domestic* Borkh) during cold storage. *J. Food Tech.* **7**: 5-11.

7. Josan, J.S., Sharma, J.N. and Chohan, G S. 1983. Effect of different lining material and wax emulsions on post-harvest life of 'Kinnow' fruits. *Indian J. Hort*. **40**: 183-87.

8. Marcilla, A., Martinez, M., Carot, J.M., Palou, L. and Rio del, M.A. 2009. Relationship between sensory and physico-chemical quality parameters of cold stored 'Clemenules' mandarins coated with two commercial waxes. *Spanish J. Agric. Res.* **7**: 181-89.

9. Salvador, A. 1999. Estudio de la aptitude para la desverdizacion de nuevas variedades 'Clemenpons', 'Loretina' y 'Beatriz'; y ei comportamiento en frigoconservacion de las mandarinas ' Ellendalle' y 'Ortanique'. Doctoral thesis. Valencia Politechniic University, Valencia, Spain (in Spanish).

10. Randhawa, J.S., Jawandha, S.K. and Gill, P.P.S. 2009. Effect of high density polyethylene packaging with edible oil and wax coating on storage quality of 'Kinnow'mandarin. *J. Food Sci. Tech.* **46**: 169-71.

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